

## Stress, burnout, and coping strategies of frontline nurses during the COVID-19 epidemic in Wuhan and Shanghai, China

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23 **psychology**

24 **ABSTRACT**

25 **Background:** Nurses at the frontline of caring for COVID-19 patients might experience mental  
26 health challenges and supportive coping strategies are needed to reduce their stress and burnout. The  
27 aim of this study was to identify stressors and burnout among frontline nurses caring for COVID-19  
28 patients in Wuhan and Shanghai and to explore perceived effective morale support strategies.

29 **Method:** A cross-sectional survey was conducted in March 2020 among 110 nurses from Zhongshan  
30 Hospital, Shanghai, who were deployed at COVID-19 units in Wuhan and Shanghai. A COVID-19  
31 questionnaire was adapted from the previous developed 'psychological impacts of SARS'  
32 questionnaire and included stressors (31 items), coping strategies (17 items), and effective support  
33 measures (16 items). Burnout was measured with the Maslach Burnout Inventory

34 **Results:** Totally, 107 (97%) nurses responded. Participants mean age was 30.28 years and 90.7%  
35 were females. Homesickness was most frequently reported as a stressor (96.3%). Seven of the 17  
36 items related to coping strategies were undertaken by all participants. Burnout was observed in the  
37 emotional exhaustion and depersonalization subscales, with 78.5% and 92.5% of participants  
38 presenting mild levels of burnout, respectively. However, 52 (48.6%) participants experienced a  
39 severe lack of personal accomplishment. Participants with longer working hours in COVID-19  
40 quarantine units presented higher emotional exhaustion (OR=2.72, 95%CI 0.02-5.42; p=0.049) and  
41 depersonalization (OR=1.14, 95%CI 0.10-2.19; p=0.033). Participants with younger age experienced  
42 higher emotional exhaustion (OR=2.96, 95%CI 0.11-5.82; p=0.042) and less personal  
43 accomplishment (OR=3.80, 95%CI 0.47-7.13; p=0.033).

44 **Conclusions:** Nurses in this study experienced considerable stress and the most frequently reported  
45 stressors were related to families. Nurses who were younger and those working longer shift-time  
46 tended to present higher burnout levels. Psychological support strategies need to be organized and  
47 implemented to improve mental health among nurses during the COVID-19 pandemic.

48 **INTRODUCTION**

49 COVID-19, a novel coronavirus featuring human-to-human transmission (1) and has spread  
50 throughout the world since its outbreak in December 2019 with thousands of new cases emerging  
51 daily during its peaks (2). The world has experienced several pandemics of contagious diseases in the  
52 past two decades such as SARS in 2003, H1N1 in 2009, Ebola, Zika and MERS in 2014~2016 (3).  
53 High levels of psychological stress have been documented among nurses who cared for infected  
54 patients during these disease outbreaks (4-6).

55 Frontline nursing and medical staff, especially in the early stages of epidemics, have suffered from  
56 anxiety and depression due to high workload, insufficient personal protective equipment, lack of  
57 knowledge of the pathogen and direct contact with patients (7-10). Consequently, nurses have  
58 commonly reported to experience a greater decline of morale and decreased job satisfaction due to  
59 the nature of the profession (11). Therefore, mental health initiatives are important to support nurses  
60 and doctors during an unprecedented health crisis of a pandemic (12, 13).

61 Burnout syndrome, a state of emotional exhaustion, is prevalent among nurses working in critical  
62 care areas across the world. A review and meta-analysis of 13 included studies using the Maslach  
63 Burnout Inventory (MBI) with a total sample of 1,566 emergency nurses revealed that burnout  
64 prevalence is high (14). Around 30% of the included nurses showed burnout in each of the three  
65 subscales of the MBI with the highest affected levels in the Depersonalization subscale followed by  
66 the Emotional Exhaustion and Personal Accomplishment subscales (14). A study among 3,100 nurses  
67 and 992 physicians working in 159 Asian intensive care units documented that nurses and physicians  
68 had high levels of burnout, 52% and 50.3% respectively (15).

69 Studies revealed that the factors related to working environment, shift work, and workloads can lead  
70 to the burnout among clinical nurses (16). Consequently, this can negatively impact the quality and  
71 safety of patient care. The emergent infection disease outbreaks expose nurses to risks of infection  
72 and may trigger or aggravate burnout levels among frontline nurses. A study investigating factors of  
73 burnout among nurses working at the frontline during the SARS outbreak identified that nurses who  
74 were single and having been quarantined during the outbreak had higher level of depressive  
75 symptoms (17). Subsequently, three years later, this group of nurses who also had been exposed other  
76 traumatic events experienced ongoing high level of depression symptoms (17).

77 During the outbreak of COVID-19 in China, medical teams nationwide have been assigned to  
78 support local health workers in Wuhan, Hubei Province, the area that has been worst affected by the  
79 pandemic. Zhongshan Hospital of Fudan University, a tertiary teaching hospital in Shanghai,  
80 organized a medical team consisting of 30 physicians and 104 nurses to support hospitals in Wuhan  
81 (18). Additionally, another six nurses were deployed to the Shanghai Public Health Medical Center, a  
82 COVID-19-designated hospital (19). These nurses had at least three-year work experience in  
83 emergency, critical care, respiratory and infection departments. The frontline nurses took over two  
84 intensive care units with 34-beds respectively. They left their families and lived in the designated  
85 hotels. Additionally, they cared for COVID-19 infected patients with new colleagues in a new  
86 working environment. All of these were exposed to an extremely stressful environment.

87 The unknown and uncertain hospital environment with COVID-19 patients may aggravate burden  
88 and increase stress among nurses while fighting the epidemic. To address these mental health  
89 challenges and well-being of nurses who work in the frontline of the COVID-19 pandemic,  
90 psychological support should be provided by hospital management and organizations that meet the

91 needs of these vulnerable group of nurses. Therefore, the aim of this study was to identify stressors  
92 and burnout among nurses who cared for COVID-19 patients during their stay in the frontline and to  
93 explore coping strategies and perceived effective support factors to address stressors.

## 94 MATERIALS AND METHODS

### 95 Design and procedure

96 A prospective observational survey design was adopted for this study. The guideline ‘The  
97 Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement:  
98 guidelines for reporting observational studies’ was used to report the study (20). A total of 110 nurses  
99 were eligible to participate, including 104 nurses in Wuhan Renmin hospital and six nurses in  
100 Shanghai Public Health Medical Center. The two designated hospitals both admitted COVID-19  
101 patients only. The study and questionnaires were designed in 25-29 February and was conducted  
102 using an online survey platform between 10-14 March 2020. At that time, participants had worked on  
103 the frontline for more than one month, and all participants cared for severe and critically ill COVID-  
104 19 patients.

### 105 Measures

106 Sociodemographic variables were collected. These included age ( $\leq 30$  years or  $>30$  years), gender,  
107 marital status, family composition (number of children), education degree, nursing degree, work  
108 experience ( $\leq 8$  years or  $>8$  years), work environments (quarantine, semi-quarantine or COVID-19  
109 free units), and working hours per week of those working in quarantine areas.

110 A self-administered COVID-19 questionnaire was adapted from a survey designed and used during  
111 the SARS epidemic measuring the psychological impacts of SARS of frontline nurses (21). Several  
112 items were modified and added through an online panel discussion and consultation with five  
113 frontline nurses. The content validity index (CVI) of the revised questionnaires was 9.4. A pilot study  
114 with 23 nurses confirmed the acceptability of the final version of the COVID-19 questionnaire. The  
115 final COVID-19 questionnaire included three subscales: 1) Stressor subscale including 31 items with  
116 a 4-point answer option scale (0=not at all; 1=slightly; 2=moderately; 3=very much); 2) Coping  
117 strategies subscale including 17 items with a 4-point answer option scale (0=almost never;  
118 1=sometimes; 2=often; 3=almost always); and 3) Effective support subscale including 16 items with  
119 a 4-point answer option scale (0=not effective; 1=mildly effective; 2=moderately effective; 3=very  
120 effective).

121 Burnout was measured using the 22-item Maslach Burnout Inventory (MBI), developed and  
122 validated by Maslach and Jackson, and is divided into three subscales: Emotional Exhaustion (EE, 9  
123 items), Depersonalization (DP, 5 items) and Lack of Personal Accomplishment (PA, 8 items) (22,23).  
124 The EE subscale measures feelings of being emotionally strained and exhaustion by own work. The  
125 DP subscale measures an unfeeling and impersonal response toward the recipients of care. Higher  
126 mean scores relate to a higher degree of experiencing burnout. The items in the PA subscale measure  
127 feelings of competence and successful achievements. Scores of this subscale are reversed and lower  
128 mean scores indicate a higher degree of experienced burnout. Each item of the MBI is scores on a 7-  
129 point scale ranging from 0 (never) to 6 (every day). The range of the subscales scores are; EE=0-54,  
130 DP=0-30, and PA=0-48 (reversed).

### 131 Data Analysis

132 The analyses were performed using IBM-SPSS version 22.0 (IBM, New York, NY, USA) and R  
 133 statistical software (R, version 3.5.1; R Project). Normally distributed measurement data are  
 134 presented as mean and standard deviation, and categorical data are presented as frequency  
 135 (percentage). Normally distributed continuous variables were compared using one-way analysis of  
 136 variance. The Pearson  $\chi^2$  test was applied to all categorical variables. A restricted cubic spline was  
 137 employed to estimate the relation between age and working time in quarantine areas and burnout  
 138 level. The internal consistency of the two questionnaires on subscale level was calculated by  
 139 Cronbach's alpha. All significance tests were two-sided, and  $P < 0.05$  was considered statistically  
 140 significant.

## 141 **Ethics**

142 The study was approved by the Research Ethics Committee of Zhongshan Hospital, Fudan University  
 143 (B2020-075). The study was conducted in accordance with the International Council for  
 144 Harmonization and Good Clinical Practice principles. The study adhered to the ethical principles  
 145 stated in the Declaration of Helsinki (24). Informed consent was obtained from each participant  
 146 before data collection. Participants could withdraw from the study at any time without providing a  
 147 reason. The survey was anonymous, and confidentiality of information was assured.

## 148 **RESULTS**

### 149 **Demographic characteristic**

150 A total of 107 (97%) participants responded to the questionnaires. Participants had a mean age of  
 151 30.28 (SD 5.49) years, and 66.36% of the nurses were under 30 years old. Most frontline nurses were  
 152 female (90.65%), 42.06% were married, and 30.84% had children. The mean work experience was  
 153 8.63 (SD 6.45) years, and 67.29% had worked for less than 8 years. Among the 107 participants,  
 154 91.59% have worked in quarantine areas (**Table 1**).

### 155 **COVID-19 questionnaire**

156 The COVID-19 questionnaire with the three subscales revealed adequate internal consistency  
 157 measures. The Cronbach's  $\alpha$  of three subscales were: Stressors,  $\alpha$  0.90; Coping Strategies,  $\alpha$  0.77;  
 158 Effective Support,  $\alpha$  0.84.

159 Among the 31 items of the subscale Stressors in the COVID-19 questionnaire, the stressors that  
 160 ranked and scored highest were homesickness (96.3%, mean 1.97), followed by uncertainty how long  
 161 the current working status will last (85.0%, mean 1.19), worrying I might get infected myself (84.1%,  
 162 mean 1.05), prolonged wearing of protective equipment will damage my skin (75.7%, mean 1.11),  
 163 and discomfort caused by protective equipment (75.7%, mean 1.07) (**Table 2**).

164 In the subscale Coping Strategies, the top 5 common strategies indicated by participants to cope with  
 165 stress were: Taking preventive measures; Actively learning about COVID-19; Actively learning  
 166 professional knowledge; Adjusting attitude and facing the COVID-19 epidemic positively; and  
 167 Chatting with family and friends (**Table 3**). Seven of the 17 coping items were performed by all  
 168 study participants (**Table 3**).

169 All 16 items listed in the subscale Effective Support were regarded as effective measures by most  
 170 frontline nurses. Seven items were rated as an effective support measure by all participants. The top  
 171 five ranked most effective support measures to reduce stress as perceived by the study participants

172 were: Support from supervisors; Sufficient material supply; Allowance provided by government;  
173 Clear instruction on treatment procedures; and Adequate knowledge of COVID-19 (**Table 4**).

#### 174 **Burnout inventory**

175 The Cronbach's  $\alpha$  coefficients for the subscales Emotional Exhaustion, Depersonalization, and Lack  
176 of Personal Accomplishment were 0.88, 0.80, and 0.75, respectively. The results retrieved from the  
177 MBI questionnaire of our frontline nurses are presented in **Table 5**. The overall mean score in the  
178 subscale Emotional Exhaustion was 12.27 (SD 7.14) with most of the scores being mild (scores  $\leq 16$ ,  
179  $n = 84$ , 78.5%) among the participants. The Depersonalization subscale revealed only mild burnout  
180 score with most of the participants having a score  $\leq 16$  (overall subscale mean score: 2.07; SD 2.78).  
181 However, 52 (48.6%) participants experienced a severe lack of personal accomplishment.

#### 182 **Associated factors of burnout level**

183 Subgroup analysis was conducted to explore the burnout level in different subgroups. Participants  
184 with younger age, less working experience and longer working time in quarantine areas presented  
185 higher burnout levels in the subscale Emotional Exhaustion. A higher level of burnout in the subscale  
186 Depersonalization was observed among participants in the subgroup with longer working time in  
187 quarantine areas. Participants with younger age, lower degrees and longer work experience showed  
188 less burnout in the subscale Lack of Personal Accomplishment (**Supplementary Material 1**).  
189 Burnout levels related to Emotional Exhaustion and Depersonalization decreased with increasing age  
190 and working time in quarantine areas (**Figure 1**).

#### 191 **DISCUSSION**

192 This study aimed to explore the main stressors and burnout and investigated how nurses release their  
193 stress. This information may provide evidence for hospitals to offer appropriate support to frontline  
194 nurses during their stay on the frontline.

195 Participants in our study were relatively young and less experienced, however, were motivated to  
196 work on the frontline. Consistent with previous findings, our study showed that a significant  
197 proportion of participants reported multifaceted stress of various severities. Loneliness has been  
198 recognized in other studies as a major stressor among nurses working in quarantine areas during  
199 epidemic outbreaks (25, 26). This issue is undoubtedly magnified among our study participants since  
200 they had to separate from their families and stay at designated hospitals during their placements.  
201 Stressors related to families, 'homesickness', 'the epidemic may endanger my family members', and  
202 'I might pass the virus to my family because of my occupation', ranked high among our study  
203 participants. Organizations should provide support to their families to help frontline nurses feel  
204 assured. Our hospital union arranged home visits and provided necessary assistance to relieve nurses'  
205 concerns. Correspondingly, family support is highly valued by frontline nurses during these stressful  
206 periods (27).

207 Most nurses worked in quarantine areas and cared for critically ill COVID-19 patients while wearing  
208 personal protective equipment. As a consequence, several stressors were related to the personal  
209 protective equipment, including 'prolonged wearing of protective equipment will damage my skin',  
210 'discomfort caused by protective equipment', and 'delivering suboptimal nursing care because of  
211 inconvenience associated with wearing protective equipment', which has been confirmed by  
212 FitzGerald and colleagues during the H1N1 Influenza 2009 epidemic (4). Skin protectors could be  
213 offered to key-workers to relieve the pressure and discomfort associated with protective equipment.

214 The human-to-human transmission characteristics of COVID-19 expose health workers at high risk.  
215 As expected, the stressor of ‘worrying I might get infected myself’ ranked high which is echoed in  
216 other previous studies (28, 29), while ‘hearing about hospital workers who were infected or died’  
217 also aggravated the concern about being infected. During the SARS outbreak in Hong Kong in 2003,  
218 staff who noticed that co-workers were infected found this as the most distressing experience evoking  
219 fear about their own personal vulnerability (5).

220 It is encouraging to notice that nurses on the frontline positively taking measures to cope with stress.  
221 Khalid et al.<sup>19</sup> noted that strict protection is essential in helping hospital staff through the epidemic  
222 (30). All participants in our study undertook preventive measures in the working areas. Nurses’  
223 concern about inadequate expertise in handling challenging tasks was noted in previous epidemic  
224 outbreaks (17,28) and is also common among the frontline nurses in our study. All nurses have been  
225 actively obtaining new knowledge about COVID-19 to build their confidence in providing care.

226 Only a small proportion of participants reported the need to see a psychiatrist, indicating that most  
227 nurses managed to adapt to the situation by themselves, which was similar to the results of another  
228 COVID-19 study on mental health issues among medical staff (31). In previous studies involving  
229 nurses with first-hand experience caring for patients during a disease outbreak, 19% had alcohol  
230 abuse/dependence (32), 8.8% experienced severe depression (30). Several studies showed 10-33%  
231 nurses had posttraumatic stress disorder symptoms (27, 32-33). Moreover, previous studies also  
232 demonstrated nurses continued to experience a degree of psychological impact after the pandemic  
233 had receded (34, 35). In our study, a small number of participants who had a negative response to  
234 stress might be at high-risk for mental health disorders. Continuous attention should be paid to these  
235 groups, and psychological intervention should be applied in a timely manner.

236 We also investigated the burnout level of participants to explore emotional reactions to stressors.  
237 Fortunately, most participants reported normal mental health conditions comparable with nurses in  
238 regular working environments (36, 37). A few participants showed moderate to severe emotional  
239 exhaustion and depersonalization after one month working on the COVID-19 frontline. We noted  
240 that nearly half of the participants presented a severe lack of personal accomplishment. We speculate  
241 that this might be associated with the severity and rapid progression of COVID-19 infections. There  
242 is no effective treatment for the disease so far. Although various supportive measures have been  
243 applied, numerous patients rapidly deteriorate to critical conditions and die. This might decrease  
244 nurses’ confidence and feeling of personal accomplishment. In the subgroup analysis of factors  
245 associated with burnout level, we found that participants with younger age and longer working time  
246 in quarantine areas showed higher levels of burnout. This might be related to the inexperience of  
247 young nurses. Their lack of opportunities to witness critical occasions might make them more  
248 vulnerable when facing death of patients due to COVID-19. Continuous attention and psychological  
249 assistance should be offered to these vulnerable group of nurses.

250 In our study, most explored support measures were reported to be effective by participants. Support  
251 from team leaders and sufficient material supply were considered the most important measures.  
252 Additionally, benefits such as an allowance, career promotion and nutrition supply should be  
253 provided to encourage frontline nurses. Adequate understanding of COVID-19 could increase nurses’  
254 confidence and sufficient training should be offered. Experience from senior staff and encouragement  
255 from colleagues were also considered effective. Several morale supportive interventions for nurses  
256 working in highly stressful environments have been identified in previous studies, including positive  
257 attitudes in the workplace and acknowledgement of their efforts (29, 37), social and family support  
258 (37), clear communication of directives (34), and support from supervisors and hospitals (27, 28, 39).

259 Nurses especially appreciate the offering of counselling/psychiatric services (5, 21, 26) and financial  
260 compensation (5, 41) from the organization.

261 This study has several limitations. Firstly, our participants were from a single hospital in Shanghai,  
262 and the generalizability of the findings to other populations remains to be verified. Secondly, the  
263 questionnaire originated from a previous study and was revised by our study team. Further  
264 verification based on a larger sample should be considered. Thirdly, we recognize the disadvantages  
265 of self-administered questionnaires which may limit the depth of the experiences (42, 43). Adding  
266 open-ended questions or interviews with nurses might contribute to a better understanding of the  
267 impact of COVID-19 in clinical practice. Finally, this study was a cross-sectional observational  
268 study. Follow-up on the short-term and long-term psychological impacts of epidemics need to be  
269 investigated in future studies.

270 In conclusion, nurses who cared for COVID-19 patients in this study experienced considerable stress,  
271 and the most frequently reported and serious stressors were related to families. Most frontline nurses  
272 positively undertook strategies to cope with stress. Nurses who were younger and who worked longer  
273 time in quarantine areas tended to present higher burnout levels. Morale support interventions,  
274 including management support, material support and allowances, should be considered to support  
275 frontline nurses in their social and psychological well-being.

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402

#### 403 **Conflict of Interest**

404 The authors declare that the research was conducted in the absence of any commercial or financial  
405 relationships that could be construed as a potential conflict of interest.

#### 406 **Author Contributions**

407 YZ, JML and CZ initiated the study. YZ, SC, JG, XH, JML contributed to the design of the study.  
408 CW, WP, JZ contributed to the data collection. JG, SC, YZ contributed to the data analysis and  
409 interpretation. YZ, SC and JML drafted the first manuscript. All authors contributed to manuscript  
410 revisions, read and approved the final version of the manuscript. All authors agree to be accountable  
411 for the content of the work.

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### 418 **Data Availability Statement**

419 The dataset is available from the corresponding authors upon request.

420

421 **Table 1.** Characteristics of participants (n=107)

<b>Characteristics</b>	<b>n (%)</b>
<b>Age</b>	
≤30 years	71 (66.36)
>30 years	36 (33.64)
Female	97 (90.65)
Married	45 (42.06)
Have Children	33 (30.84)
<b>Education Degree</b>	
College	32 (29.91)
Bachelor and above	75 (70.09)
<b>Nursing Degree</b>	
RN	86 (80.37)
APN or head nurse	21 (19.63)
<b>Work experience</b>	
≤8 years	72 (67.29)
>8 years	35 (32.71)
<b>Working environments and work hours</b>	
Quarantine areas	98 (91.59)
≤10 hours per week	31 (31.63)
10-20 hours per week	58 (59.18)
>20 hours per week	9 (9.19)
Semi-quarantine areas	44 (41.12)
COVID-19 free areas	27 (25.23)

422 RN=registered nurse; APN=advanced practice nursing.

423 **Table 2.** Stressors and stress severity (n=107)

Items	n (%) <sup>a</sup>	mean (SD) <sup>b</sup>
Homesickness	103 (96.3)	1.97 (0.926)
Unsure how long the current working status will last	91 (85.0)	1.19 (0.791)
Worrying I might get infected myself	90 (84.1)	1.05 (0.664)
Prolonged wearing of protective equipment will damage my skin.	81 (75.7)	1.11 (0.850)
Discomfort caused by protective equipment	81 (75.7)	1.07 (0.832)
Uncertainty about when the epidemic will mitigate	81 (75.7)	1.01 (0.771)
Non-nursing tasks (cleaning, collecting garbage, make tea, etc.)	80 (74.8)	1.44 (1.100)
The epidemic may endanger my family members	80 (74.8)	0.98 (0.777)
Hearing about hospital workers who were infected or died	79 (73.8)	0.94 (0.750)
I might endanger co-workers due to my carelessness	75 (70.1)	0.94 (0.822)
Concerns of inadequate knowledge and capability to handle tasks	71 (66.4)	0.74 (0.604)
I might pass the virus to my family because of my occupation.	68 (63.6)	0.90 (0.879)
Emotional reactions of patients	65 (60.7)	0.71 (0.659)
I might put burden on colleagues due to my physical insufficiency	63 (58.9)	0.64 (0.635)
Patients' condition worsening	59 (55.1)	0.71 (0.659)
Fear of nosocomial transmission of virus	58 (54.2)	0.65 (0.715)
Delivering suboptimal nursing care because of inconvenience associated with wearing protective equipment	55 (51.4)	0.64 (0.756)
I might endanger patients due to my carelessness.	53 (49.5)	0.62 (0.748)
The conflict between nursing responsibility and personal safety	50 (46.7)	0.51 (0.589)
I might not work well with new colleagues (nurses and doctors)	41 (38.3)	0.42 (0.567)
Lacking proper work environment	40 (37.4)	0.45 (0.662)
Emotional reactions of patients' family	34 (31.8)	0.36 (0.554)
Emotional instability of colleagues	33 (30.8)	0.35 (0.568)
Unfamiliar with infection control regulations	33 (30.8)	0.34 (0.531)
Concerns over insufficient manpower	29 (27.1)	0.34 (0.629)
Lack of protective material supply	29 (27.1)	0.30 (0.518)
Unclear documentation & reporting policy	26 (24.3)	0.25 (0.458)
Criticism or blame from supervisors	23 (21.5)	0.21 (0.413)
Confusion of responsibilities between physicians and nurses	17 (15.9)	0.17 (0.400)
Presenting COVID-19-like symptoms myself	16 (15.0)	0.18 (0.472)
Colleagues presenting COVID-19-like symptoms	15 (14.0)	0.17 (0.468)

424 <sup>a</sup>Number and proportion of a score  $\geq 1$  for each item; <sup>b</sup>Severity was rated on a 4-points scale (0=not  
425 at all; 1=slightly; 2=moderately; 3=very much), score of severity calculated as mean (SD).

426 **Table 3.** Coping strategies (n=107)

Items	n (%) <sup>a</sup>	mean (SD) <sup>b</sup>
Taking preventive measures (handwashing, wearing face masks, taking the temperature, etc.)	107 (100.0)	2.99 (0.097)
Actively learning about COVID-19 (symptoms, route of transmission)	107 (100.0)	2.87 (0.391)
Actively learning professional knowledge (including ECMO, ventilator, etc.)	107 (100.0)	2.82 (0.472)
Adjusting the attitude and facing the COVID-19 epidemic positively	107 (100.0)	2.79 (0.450)
Chatting with families and friends	107 (100.0)	2.76 (0.511)
Recreational activities (music, sports, safari, etc.)	107 (100.0)	2.75 (0.497)
Engaging in health-promoting activities (proper rest, exercise, balanced diet)	107 (100.0)	2.71 (0.550)
Seeking psychological support from colleagues	92 (86.0)	1.65 (1.047)
Seeking information regarding mental health	91 (85.0)	1.52 (1.040)
Participating Balint groups	88 (82.2)	1.13 (0.802)
Practicing relaxation methods (meditation, yoga, Taiji, etc.)	74 (69.2)	1.11 (1.022)
Expressing concerns and needs to supervisors	72 (67.8)	0.81 (0.715)
Limiting myself watching news related to COVID-19	40 (37.4)	0.59 (0.921)
Keeping myself busy to refrain from thinking about the epidemic	48 (44.9)	0.55 (0.704)
Taking adjuvant medication (sleep helper, etc.)	21 (19.6)	0.26 (0.588)
Releasing emotions by crying, screaming or throwing items	12 (11.2)	0.14 (0.444)

427 <sup>a</sup>Number and proportion of a score  $\geq 1$  for each item; <sup>b</sup>Frequency of measures was rated on a four-  
428 point scale (0=almost never; 1=sometimes; 2=often; 3=almost always), frequency of coping  
429 strategies calculated as mean  $\pm$  SD.

430 **Table 4.** Effective support measures (n=107)

Items	n (%) <sup>a</sup>	mean (SD) <sup>b</sup>
Support from team leaders	107 (100.0)	2.94 (0.269)
Sufficient material supply	107 (100.0)	2.93 (0.315)
Allowance provided by government	107 (100.0)	2.91 (0.351)
Clear instruction on treatment procedures	107 (100.0)	2.91 (0.351)
Adequate knowledge of COVID-19 (transmission route, treatment, etc.)	107 (100.0)	2.82 (0.472)
Priority in career promotion	107 (100.0)	2.80 (0.522)
Senior staff sharing experience	107 (100.0)	2.71 (0.614)
Strict infection control procedures within the institution	106 (99.1)	2.84 (0.517)
Educational and training programs in the hospital	105 (98.1)	2.62 (0.722)
Appropriate schedule of shift	104 (97.2)	2.90 (0.387)
Enough rest time	104 (97.2)	2.88 (0.405)
Nutrition supplement from the organization	100 (93.5)	2.23 (0.957)
Encouragement from colleagues	99 (92.5)	2.67 (0.611)
Psychological services	96 (89.7)	1.86 (1.041)

431 <sup>a</sup>Number and proportion of a score  $\geq 1$  for each item; <sup>b</sup>Effectiveness of measures was rated on a four-  
432 point scale (0=not effective; 1=mildly effective; 2=moderately effective; 3=very effective), score of  
433 perceived effectiveness calculated as mean (SD).

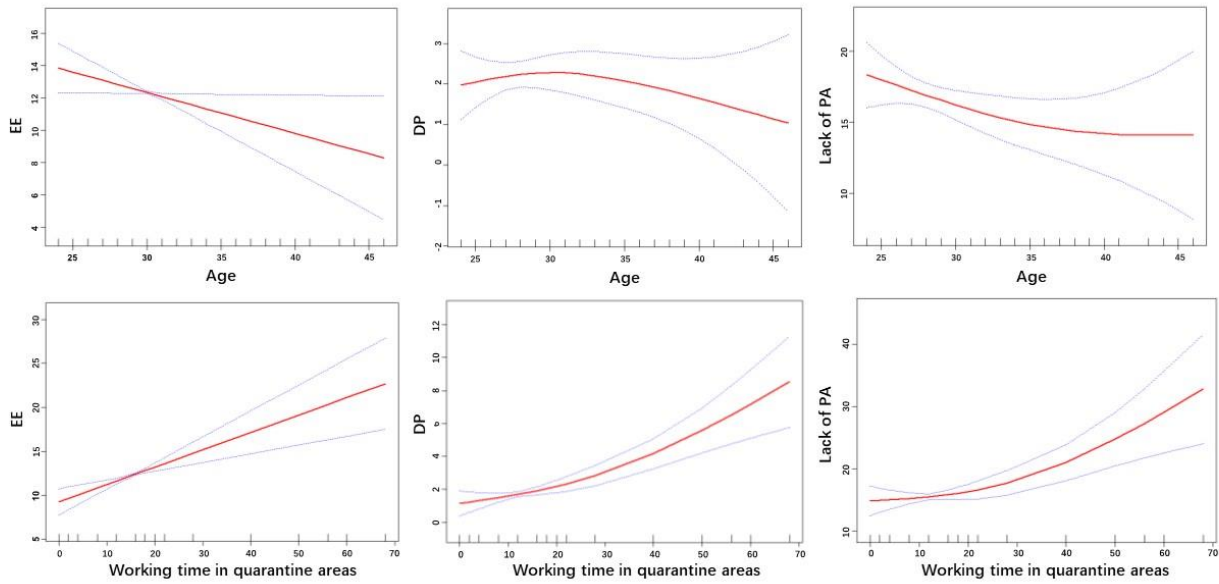


434 **Table 5.** Burnout inventory of participants (n=107)

<b>Dimension</b>	<b>n (%)</b>
<b>Emotional Exhaustion, mean (SD)</b>	<b>12.27 (7.14)</b>
Mild (scores $\leq 16$ )	84 (78.5)
Moderate (scores 17~26)	17(15.9)
Severe (scores $\geq 27$ )	6 (5.6)
<b>Depersonalization, mean (SD)</b>	<b>2.07 (2.78)</b>
Mild (scores $\leq 6$ )	99 (92.5)
Moderate (scores 7~12)	6 (5.6)
Severe (scores $\geq 13$ )	2 (1.9)
<b>Lack of Personal Accomplishment*, mean (SD)</b>	<b>16.44 (8.36)</b>
Mild (scores $\leq 9$ )	20(18.7)
Moderate (scores 10~16)	35(32.4)
Severe ( $\geq 17$ )	52(48.6)

435 \*Lack of Personal Accomplishment reversed score (max score is 48)

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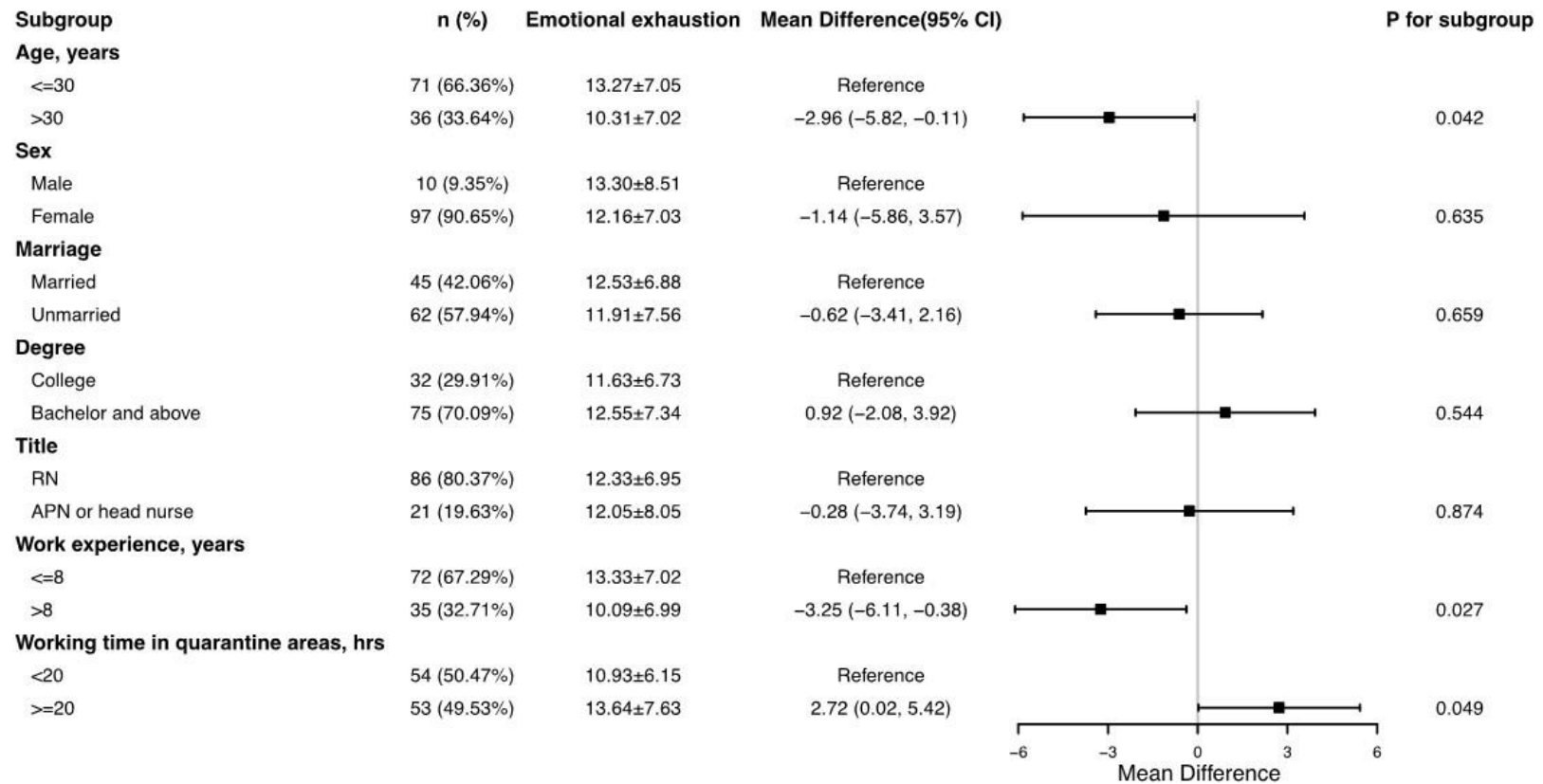
438 **Figure 1.** Relationship between age, working time in quarantine areas and three subscales of  
 439 burnout. EE=Emotional Exhaustion; DP=Depersonalization; PA=Lack of Personal Accomplishment.

## *Supplementary Material 1*

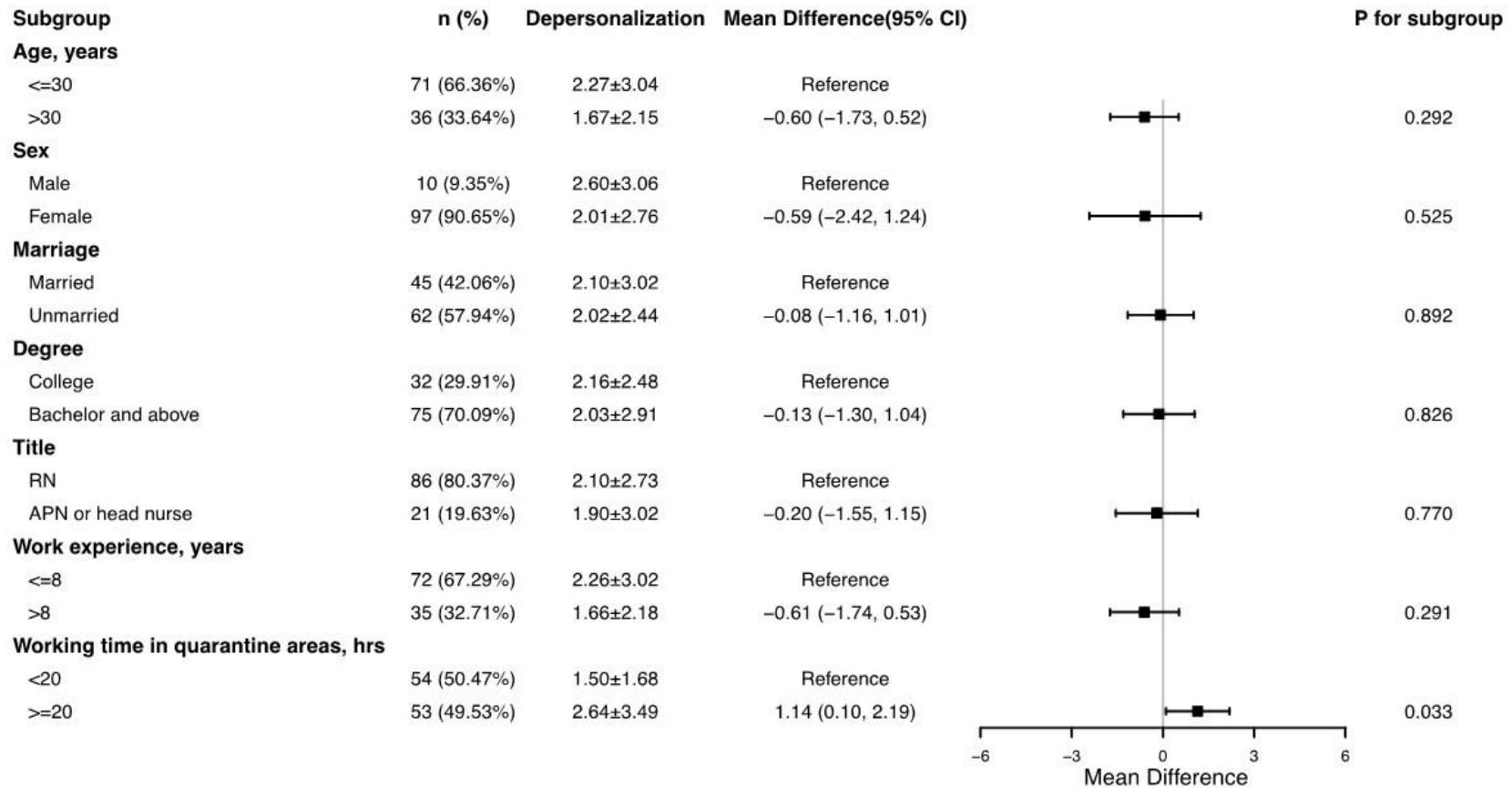
**Stress, burnout, and coping strategies of frontline nurses during the COVID-19 epidemic in Wuhan and Shanghai, China**

Yuxia ZHANG, Chunling WANG, Wenyan PAN, Jili ZHENG, Jian GAO, Xiao HUANG, Shining CAI, Yue ZHAI, Jos M. LATOUR,  
Chouwen ZHU

**Supplementary Figures 1a, 1b, 1c**

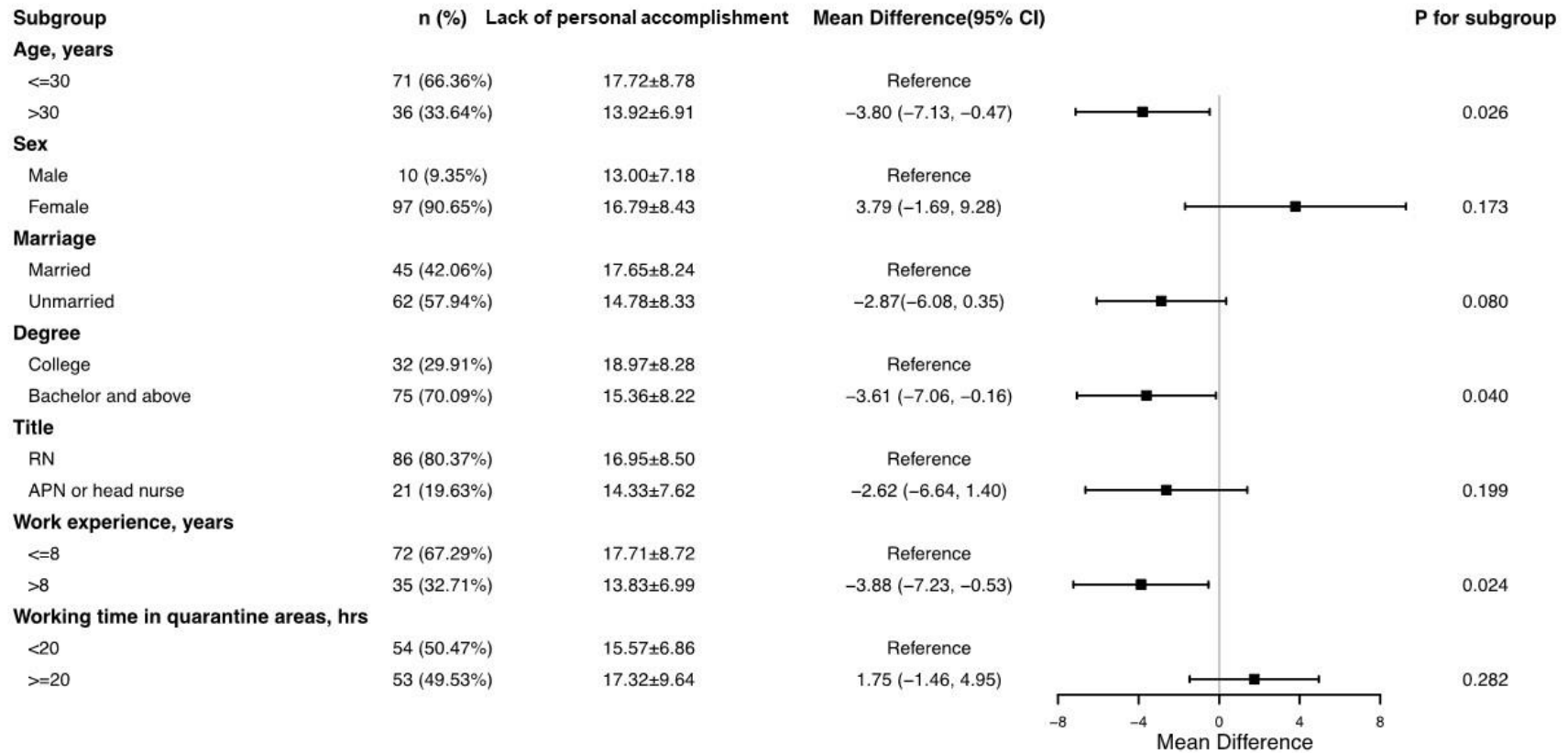


**Supplementary Figure 1a.** Subgroup analysis burnout subscale Emotional Exhaustion.  
 RN=registered nurse; APN=Advanced Practice Nurse; hrs=hours



**Supplementary Figure 1b.** Subgroup analysis burnout subscale Depersonalization.

RN=registered nurse; APN=Advanced Practice Nurse; hrs=hours



**Supplementary Figure 1c.** Subgroup analysis burnout subscale Lack of Personal Accomplishment. RN=registered nurse; APN=Advanced Practice Nurse; hrs=hours